AC Power
For *Business-Critical Continuity™*

Liebert® PPC™ Precision Power Center

User Manual - Three Phase, 300, 450 & 800kVA; 60 Hz

EMERSON
Network Power

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SAVE THESE INSTRUCTIONS

NOTE

Read the entire manual before installing or operating the system.

WARNING

The shipping bands may be under tension. Use appropriate eye, face and hand protection to safeguard against injury from band backlash.

WARNING

Verify that all incoming line voltage (power) and low voltage (control) circuits are de-energized and locked out before installing cables or making connections, whether in the junction box or in the unit.

Equipment inspection and startup should be performed only by trained personnel. Lethal voltages are present during startup procedures. Electrical safety precautions must be followed throughout inspection and startup.

Only qualified service personnel should perform maintenance on the Liebert PPC. All voltage sources to the unit must be disconnected before inspecting or cleaning within the cabinet.

Lethal voltages exist within the equipment during operation. Observe all warnings and cautions in this manual. Failure to comply may result in serious injury or death. Obtain qualified service for this equipment as instructed.

The monitoring system contains a lithium battery for memory backup. Danger of explosion if battery is incorrectly replaced. Replace only with same or equivalent type. Dispose of used batteries according to manufacturer's instructions.

NOTE

The unit should not be loosened from the shipping pallet until after all handling by forklift or pallet jack is completed.

All power and control wiring should be installed by licensed electricians and must comply with the NEC and applicable codes.

1.0 INSTALLATION INSTRUCTIONS

1.1 Unpacking and Installation

NOTE
Read the entire manual before installing and operating the system. Upon receipt of a Liebert PPC, the installer should perform the following steps to ensure a quality installation.

1.1.1 Unpacking and Preliminary Inspection

A quality installation begins on the receiving dock.

1. Inspect the shipping crate(s) for damage or signs of mishandling before unpacking the unit(s). Check Shock-Watch indicator.
2. Open the shipping crates carefully. (Use care to avoid puncturing the container with sharp objects that would damage the contents.)
3. Remove the packing and vapor barriers and inspect the equipment for any obvious shipping damages.

NOTE
The units should not be loosened from the shipping pallet until after all handling by forklift or pallet jack is completed. Complete internal inspection should be accomplished only after equipment positioning and prior to electrical hookup.

If any damage as a result of shipping is observed, immediately file a damage claim with the shipping agency and forward a copy to:

Emerson Network Power
1050 Dearborn Drive
P.O. Box 29186
Columbus, Ohio 43229 USA

1.1.2 Handling Considerations

The Liebert PPC is bolted to a wooden pallet to allow handling by forklift equipment.

- **Easily moved** - The Liebert PPC is furnished with casters to allow the unit to be rolled into place after it has been unbolted from the pallet.
- **Check size and weight** - Refer to **Table 1** and the cabinet drawings furnished with the unit for size and weight information.
- **Plan the route** - Decide the best route for the unit to follow to the installation area to ensure that all passages are large enough to accommodate the unit and the floors are adequate to support the weight. Is there adequate room in doorways, elevators, ramps, etc.? Are there any non-negotiable corners or offsets in the hallways?
- **Move with care** - To prevent panel damage, Emerson recommends removing the exterior panels before the unit is moved. When replacing panels, remember to reconnect all panel ground wires.

Table 1 300-800kVA Liebert PPC dimensions

kVA	Transformer Section				Distribution Side Section(s) [1]			
	Dimensions - in. (mm)			Weight lb. (kg)	Dimensions - in. (mm)			Weight lb. (kg)
	W	D	H		W	D	H	
300	43 (1092) [2]	32 (813)	77 (1956)	2450 (1111)	43 (1092) [2]	32 (813)	77 (1956)	650 (295)
450	43 (1092) [2]	32 (813)	77 (1956)	3176 (1441)	43 (1092) [2]	32 (813)	77 (1956)	650 (295)
800	87 (2210)	32 (813)	77 (1956)	6720 (3048)	43 (1092) [2]	32 (813)	77 (1956)	650 (295)

NOTES
1. 800kVA requires two (2) distribution side sections
2. Includes a 1" side panel

1.1.3 Unit Preparation

The Liebert PPC may be easily removed from the shipping pallet and installed by the user. A typical procedure follows:

1. Set the palletized assembly in a level area, where there is enough room to roll the unit and entire cable assembly off the pallet.
2. Cut the shipping bands.

WARNING

The shipping bands may be under tension. Use appropriate eye, face and hand protection to safeguard against injury from band backlash.

3. Remove the factory-provided ramp from its shipping position.
   One ramp is provided per order, packed in front of the unit. Place the ramp adjacent to the pallet to provide a smooth path from pallet to floor.
4. Remove side and rear panels from the module. An Allen wrench for the side panels is furnished in the installation packet. (Carefully disconnect panel ground wires by pulling the easy-disconnect terminals at the unit frame.)
5. Remove the bolts holding the unit to the shipping pallet in each of the four bottom corners.
6. Remove shipping blocks from under the unit, then remove chocks from all casters.
7. Roll the unit off the pallet onto the floor.
8. Roll the unit to the installation location. For units located on a raised floor, use care when positioning the unit over the floor cutout to avoid casters falling through the cutout.

CAUTION

Before maneuvering the unit into its final position, read and follow all advisories in the following section, **1.1.4 - Location Considerations**.

1.1.4 Location Considerations

The Liebert PPC should be located within the computer room and/or close to the load(s) which it is supplying. The unit should not be located over combustible surfaces.

Equipment location should employ the shortest output distribution cable runs consistent with logical equipment arrangement and allowances for future additions.

Operating Environment - Ambient temperatures of 32°F to 104°F (0°C to 40°C) with a relative humidity of 0% to 95% (non-condensing).

Top or Bottom Clearance is required for exit of cables and conduit.

- For bottom exit, this clearance is automatically provided by a raised floor—minimum height 12 in. (305mm).
- For top exit, this clearance is 18 in. (460mm).

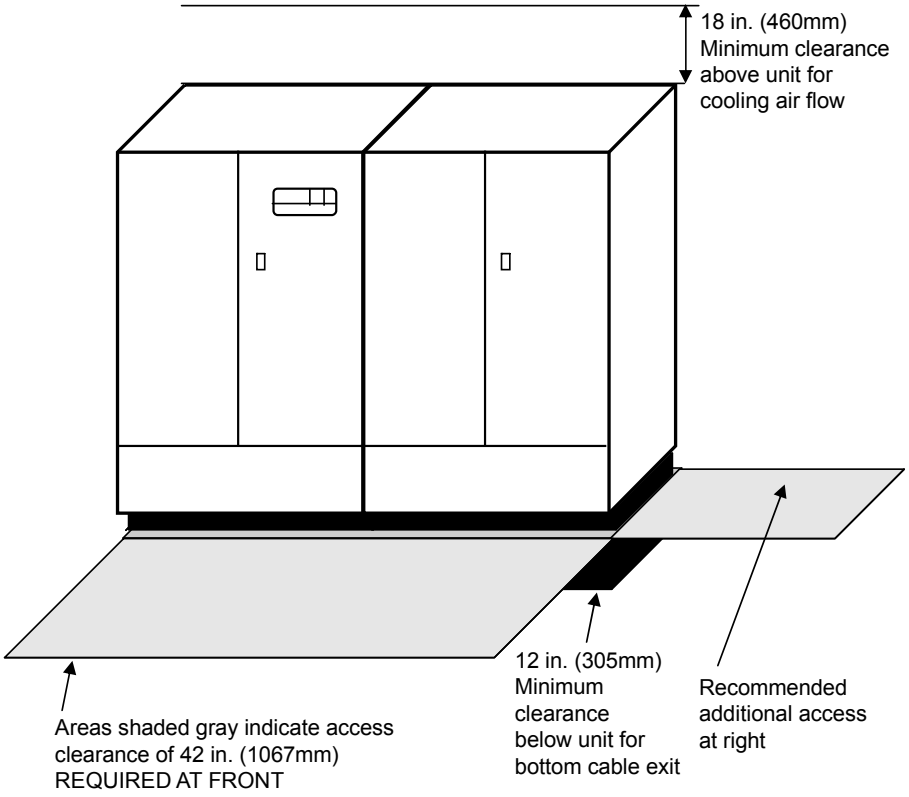
Recommended minimum service clearances are shown in **Figure 1** (300 and 450kVA units) and **Figure 2** (800kVA units). The indicated clearance at the front of the unit is required for service access by the National Electrical Code (NEC) (Article 110-26). Clearance above the unit is required for cooling air flow (exhaust).

Heat Output - Like any electrical device, the Liebert PPC produces heat under normal operation. Include this heat output (see **Table 2**) when calculating the environmental conditions of the room.

Table 2 Heat output

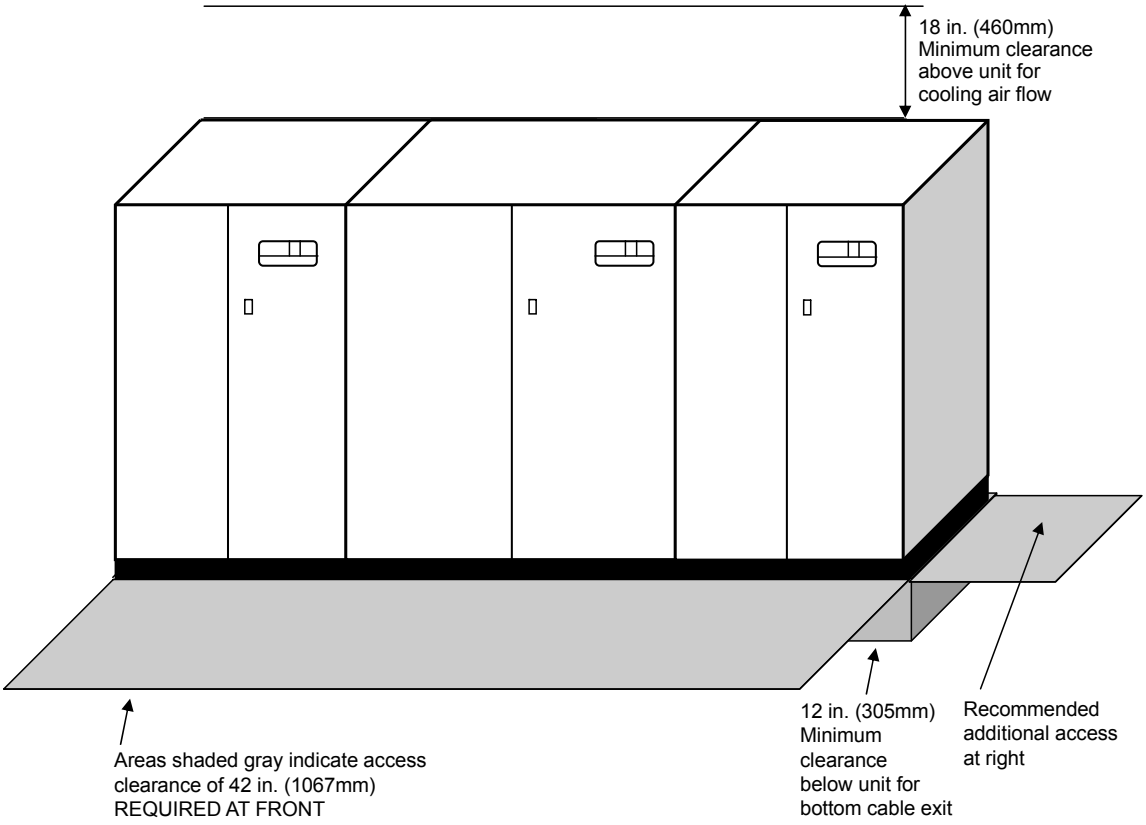
Full Load Heat Output		
kVA	**BTU/Hr**	**kW**
300	18,085	5.29
450	23,789	6.97
800	34,600	10.13

Figure 1 Recommended minimum service and ventilation clearances for 300 and 450kVA units



NOTE: Service access clearance dimensions: 42 in. (1067mm)

Figure 2 Recommended minimum service and ventilation clearances for 800kVA units



NOTE: Service access clearance dimensions: 42 in. (1067mm)

Figure 3 Footprint and floor cutout dimensions for Transformer Section - 300 and 450kVA units

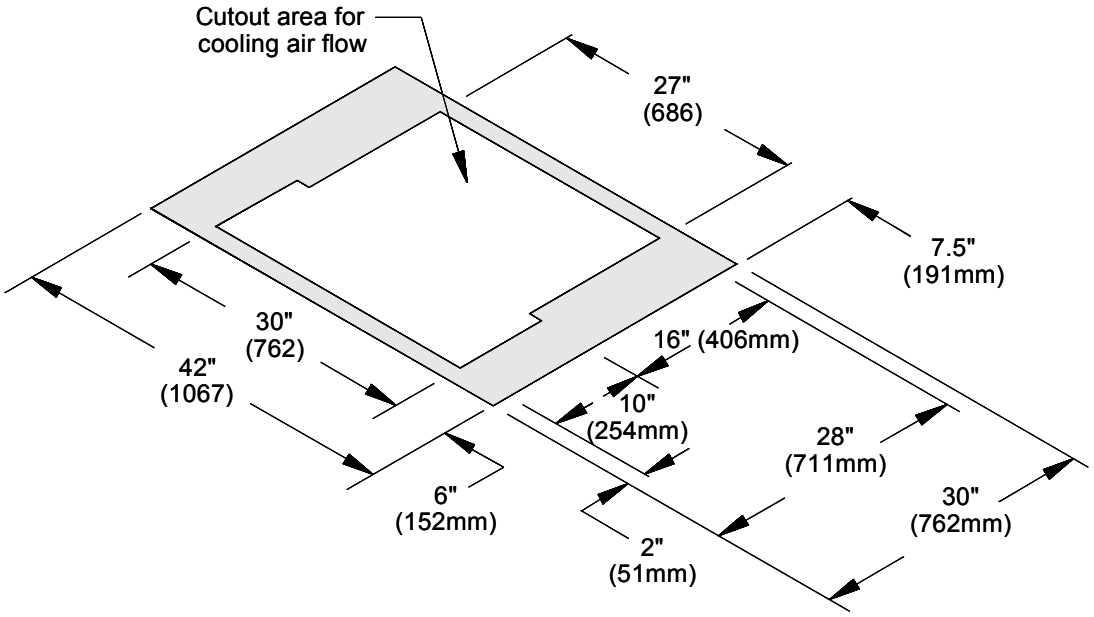


Figure 4 Footprint and floor cutout dimensions for Transformer Section - 800kVA units

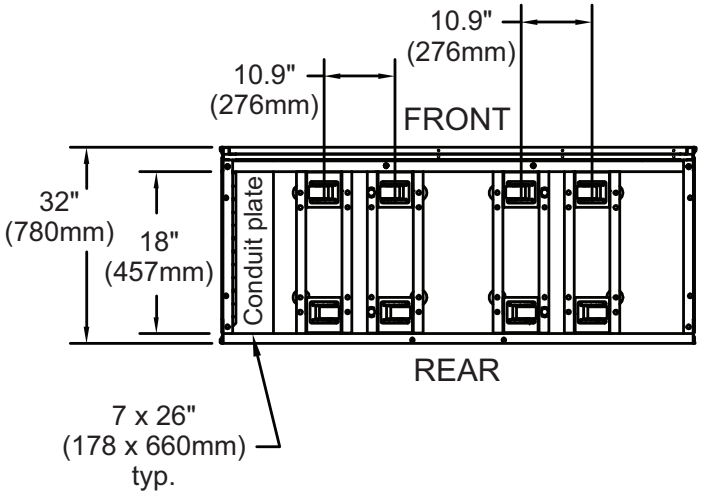
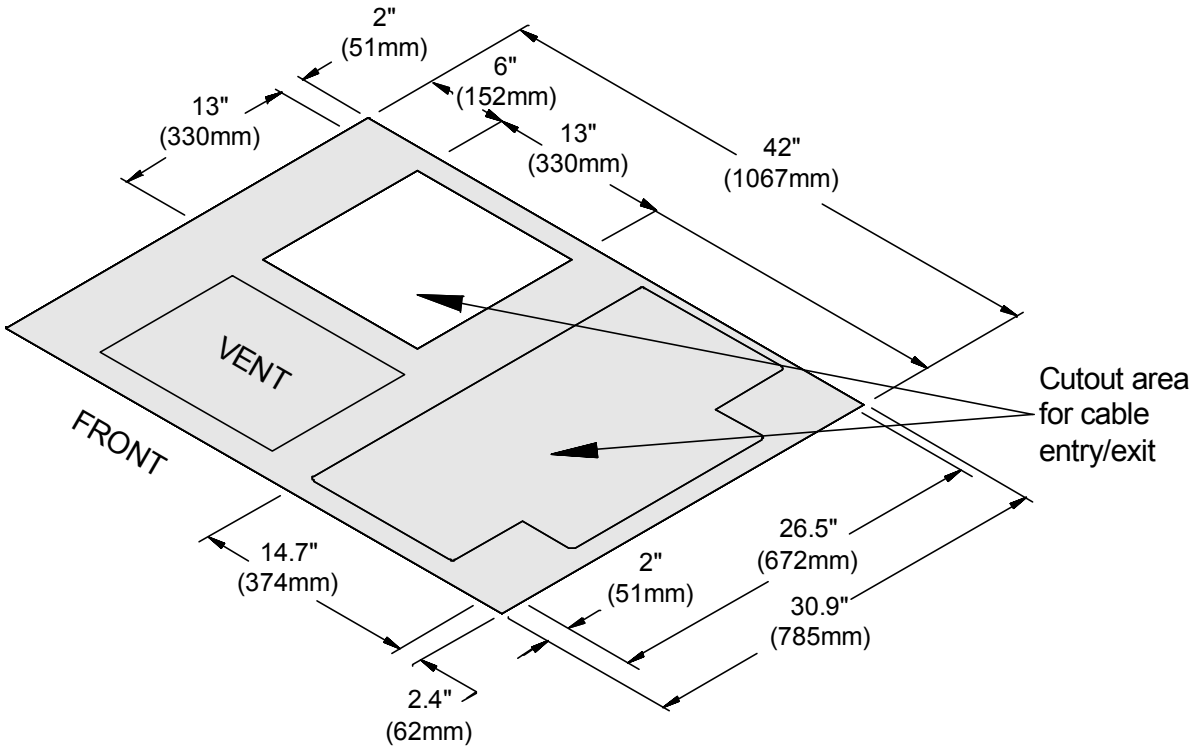


Figure 5 Footprint and floor cutout dimensions for Distribution Sections - 300-800kVA units



1.2 Power and Control Wiring

Power and control wiring should be installed by licensed electricians. All power and control wiring must comply with the NEC and applicable local codes. Refer to **Figures 6** and **7** for single-line diagrams.

1.2.1 Distribution Section Mounting and Wiring

Each 300 and 450kVA Liebert PPC requires a distribution section for routing input/output cables and to provide output distribution. Each 800kVA Liebert PPC requires two (2) distribution sections.

Distribution sections are shipped separate from the main unit. Each distribution section has base dimensions of 42 x 30 in. (1067 x 762mm) and should be mounted on the right side of the transformer section. Each 800kVA Liebert PPC requires one distribution section on each side on the transformer section.

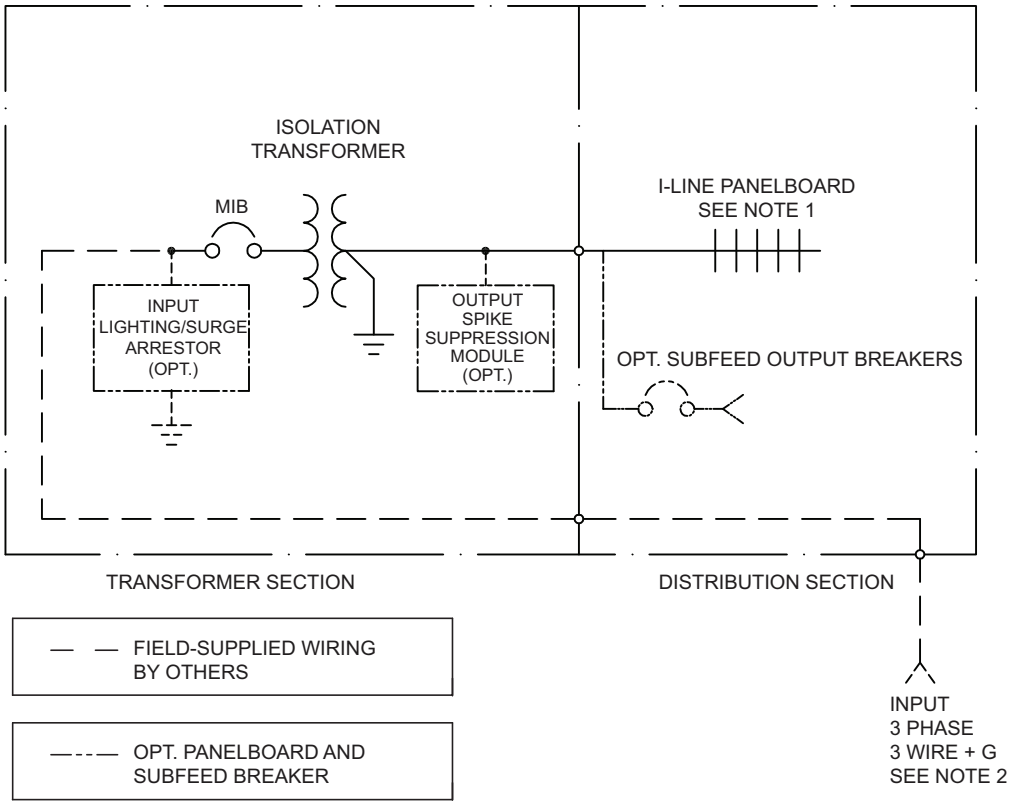
Provide a floor cutout for exit of output cables, as shown in **Figures 3**, **4** and **5**.

Align the distribution side section with the main unit and bolt the two frames together using the four bolts and hardware provided. See **Figure 1** for 300-450kVA units and **Figure 2** for 800kVA units.

300-450kVA units are shipped with a left side panel on the transformer section and a right side panel on the distribution section. 800kVA units ship with a left side panel on the left distribution section and a right side panel on the right side distribution section. The transformer section of an 800kVA unit ships without side panels.

After electrical connections are completed, install the side panels on the transformer and distribution section enclosures.

Figure 6 300-450kVA Liebert PPC single-line diagram



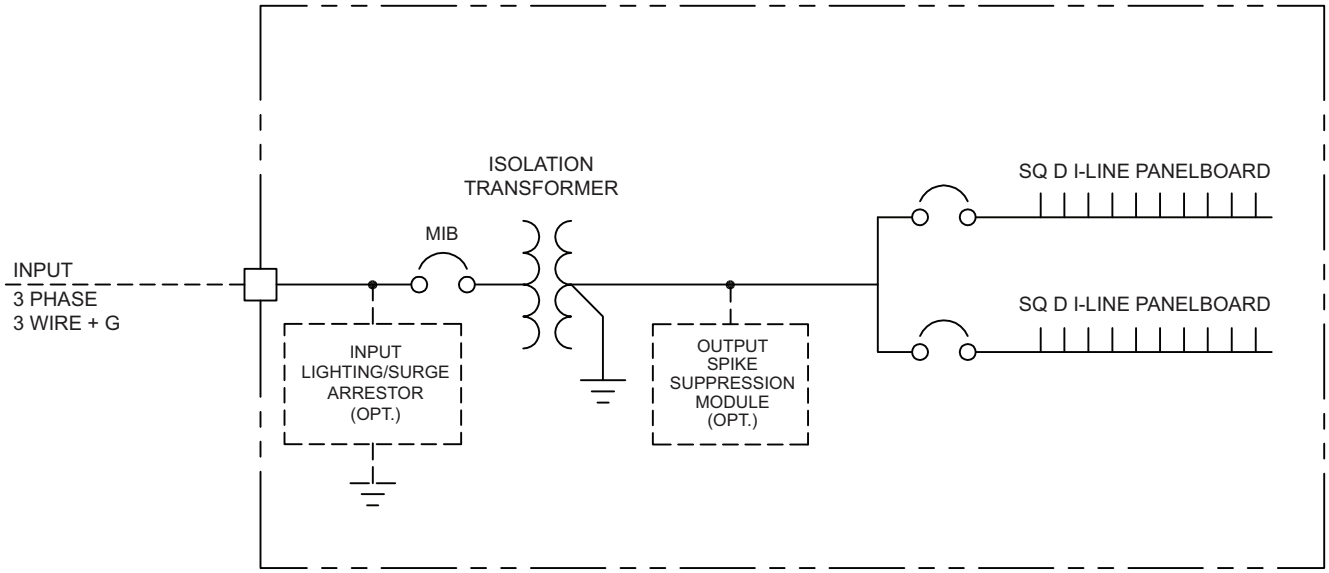
Suggested Minimum Input Wire Size				
kVA	**Input Voltage**	**Full Load Amps**	**MIB Trip Amps**	**Suggested Feeder Wire Size**
300	380	469	600	(2) 350 kcmil
	400	446	600	(2) 350 kcmil
	415	430	600	(2) 350 kcmil
	480	372	500	(2) 250 kcmil
	600	297	400	(2) #3/0 AWG
450	480	552	700	(2) 500 kcmil
	600	442	600	(2) 350 kcmil

400A - 700A MIB		
Interrupting Rating	**380-480V**	**600V**
Standard	65kA	25kA
High	100kA	50kA

NOTES:

1. The maximum number of output breakers that can be installed in an I-Line panelboard is:
   - Ten (10) 250A frame or
   - Eight (8) 400A LA frame or
   - Six (6) 600A LI frame.
2. Input is through the distribution section to the transformer section. Input cables can be through either the top or the bottom of the distribution section.

Figure 7 800kVA Liebert PPC single-line diagram



Suggested Minimum Input Wire Size				
kVA	**Input Voltage**	**Full Load Amps**	**MIB Trip Amps**	**Suggested Feeder Wire Size**
800	480	982	1200	(4) 500 kcmil
	600	785	1000	(4) 350 kcmil

1000A - 1200A MIB		
Interrupting Rating	**480V**	**600V**
Standard	65kA	25kA
High	100kA	50kA

NOTES:

1. The maximum number of output breakers that can be installed in an I-Line panelboard is:
   - Ten (10) 250A frame or
   - Eight (8) 400A LA frame or
   - Six (6) 600A LI frame.
2. Input cables can enter through either the top or the bottom of the transformer section.

1.2.2 Side-Section Electrical Connections

Five conductors (three-phase conductors, neutral and ground) are furnished with the distribution section for connection to the transformer section in the field, along with an intercabinet frame ground conductor.

For 300-450kVA units, the distribution section phase conductors are connected directly to the transformer terminals:

- Phase A (wire 14) to X1
- Phase B (wire 15) to X2
- Phase C (wire 16) to X3

The distribution section neutral (wire 47) and ground (wire 50) conductors are connected to the transformer section main ground bus bar (see unit wiring diagram shipped with unit).

For 800kVA units, each distribution section is fed from an output breaker mounted in the transformer section.

For 300-450kVA units with current monitoring, route each side-section conductor through the appropriate current transformer (CT) in the main unit.

NOTE

Distribution section conductors must pass through the current transformers in the same direction as the main unit panelboard conductors. Use the existing main unit panelboard wiring for reference.

1.2.3 Input Power Connections

The input power feeder enters through the distribution section and routes to the transformer section where it is connected to the busbars located inside the unit.

WARNING

Verify that all incoming line voltage (power) and low voltage (control) circuits are de-energized and locked out before installing cables or making connections in the unit.

To minimize disturbances caused by other loads in the building, the three-phase power input to the unit should be supplied directly from the service entrance or other power source (a dedicated power feeder).

The input feeder circuit should be sized in accordance with the NEC and any local building codes to assure the feeder's ability to safely carry the system's full load current, including losses.

Input feeder conductors should be sized for no more than 2% voltage drop. If operation at undervoltage conditions for extended periods of time is desired, the input feeders must be oversized.

Typical conductor size data is shown in **Table 3**. All connections must comply with the NEC and all other applicable codes.

The main input feeder should consist of three-phase conductors and one (safety) ground conductor (3W + G).

Table 3 AIC and suggested minimum input wire size data for OCPD

Input Volts	kVA	Input FLA	Input OCPD	Suggested feeder wire size (AWG)*	Standard kAIC
480	300	371	500	(2) 250 kcmil	65
	450	556	700	(2) 500 kcmil	65
	800	987	1200	(4) 500kcmil	65
600	300	297	400	(2) 3/0	25
	450	442	600	(2) 350 kcmil	25
	800	790	1000	(3) 500kcmil	25

FLA = Full Load Amps of Liebert PPC

OCPD = Overcurrent Protection Device inside Liebert PPC

Wire sizes based on NEC 2008 Table 310-16, using 75°C copper conductor

* Parallel feeders per NEC 2008 Sections 300-3 and 310-4.

NOTES

1. Main input power feeder should be a dedicated feeder direct from service entrance or other power source, if possible.
2. Ground conductors recommended to be insulated conductors run with power conductors for increased system performance. Ground conductor minimum size per NEC Table 250-122. Input power feeder conduit may be used as the safety ground conductor. When conduit is used, adequate electrical continuity must be maintained at conduit connections to enclosures and throughout conduit run.
3. Input feeder wire size listed is the minimum feeder size recommended. Larger wire size may be required because of voltage drop or supply overcurrent protection device.

1.2.4 System Grounding

The performance and safety of any power conditioning system depends on proper grounding. **Figure 8** shows the typical grounding arrangements for the Liebert PPC.

Equipment grounding - Proper grounding is required for safe operation but also enhances equipment performance. All power feeders must include equipment grounding means as required by the NEC and local codes. An insulated ground conductor is recommended to be run in each feeder conduit. Ground conductors must be at least the minimum size per NEC Table 250-122. Larger wire sizes may be used for increased system performance. If the input power feeder conduit is used as a grounding conductor, adequate electrical continuity must be maintained at all conduit connections.

Using isolating bushings in a metal conduit run can be a safety hazard and is not recommended.

Signal reference grid - If the unit is used to supply power to a computer room, an area equipped with a signal reference grid or a grounded raised-floor stringer system, a grounding conductor should be connected from the system ground bus to the grid or floor system. This conductor should be stranded or braided #8 AWG or larger and as short as practical. Less than 3 ft. (1m) is recommended.

1.2.5 Grounding Electrode Conductor

Required by code - The Liebert PPC should be grounded according to the safety practices of NEC 25030(a). A local grounding electrode conductor is recommended in addition to the equipment safety ground that is normally run with the input power conductors.

Electrode connection - As shown in **Figure 8**, the grounding electrode conductor is run from the unit to the nearest effectively grounded item below (shown in order of preference):

- Building steel
- Metal water pipe
- Other made grounding electrode

Sizing of the grounding electrode conductor is based on the secondary circuit conductors. According to the NEC (Table 250-66).

Recommended methods for running the grounding electrode conductor (shown in order by preference for system performance and as acceptable by local and other applicable codes):

- Outside of conduit (where not subject to damage)
- Inside non-metallic conduit
- Inside non-ferrous conduit
- Inside ferrous conduit, bonded to the ferrous conduit at both ends, as acceptable by local and other applicable codes

1.2.6 Output Power Connections

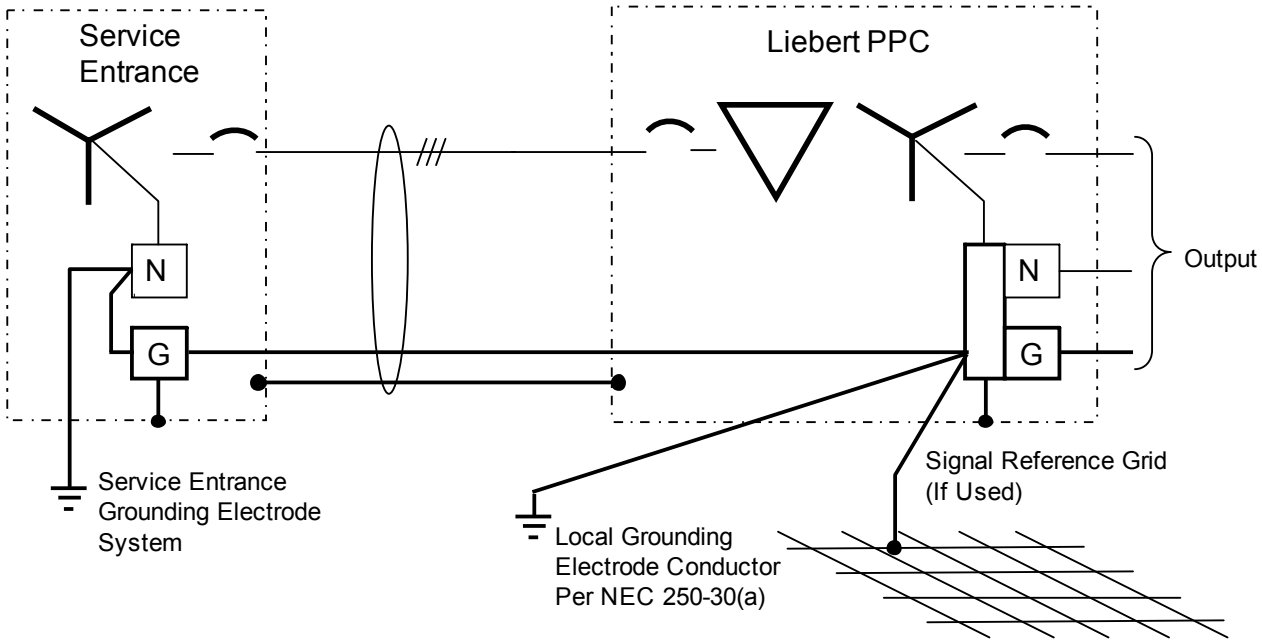
Output circuit breakers with ground and neutral provisions are available as an option for installation inside the unit for connecting loads as required.

For best performance, the Liebert PPC should be located as close to the load as practical.

Initial system output loading should be between 50% and 75% of rated capacity. This allows the addition of future loads without immediately investing in another power conditioner. The high partial-load efficiency of the unit permits such sizing without imposing an energy-use penalty during initial operation.

Keep the load balanced - Balancing of loads is good design practice on any three-phase system. Accordingly, each distribution panel is load-balanced at the factory, based on output branch circuit breaker sizes. All additions to the system should be arranged to preserve this balance.

Figure 8 Typical Liebert PPC grounding arrangement



WARNING

Verify that incoming line voltage circuits are de-energized and locked out before installing output breakers and cables.

Code compliance - All output cables and connections must comply with the NEC and all other applicable codes.

Padlock-off provisions - All output breakers that are hard-wired to the load equipment must be equipped with a padlock-off accessory for the output circuit breaker. The padlock-off accessory is used to lock out and tag the circuit breaker when service is performed on the hard-wired load equipment in accordance with OSHA safety rules.

1.2.7 Control Wiring Connections

The NEC Article 645 requires that Emergency Power Off (EPO) switches be located at the principal room exits. All standard Liebert power conditioning systems have provision for external shutdown control from Remote Emergency Power Off (REPO) stations. **Figure 9** is a simplified diagram of the shutdown circuitry of the Liebert PPC.

Low-voltage control circuit - As shown in **Figure 9**, the control circuit operates on 24VDC. The shutdown device (represented by the REPO switch) activates a low-current 24VDC relay that operates the shunt-trip mechanism. The shunt-trip solenoid opens the main input breaker, which de-energizes the Liebert PPC.

Multiple-unit shutdown - When more than one Liebert PPC is installed by the user, a typical requirement is that actuation of a single device (REPO, for example) must shut down all Liebert PPC units. The low-voltage control circuits of all standard Liebert PPC systems are designed to meet this requirement.

External control wiring connections for remote shutdown, alarm and/or monitoring are made to the low-voltage control terminal strip located inside the unit. Control wiring connections are shown in **Figure 10**.

Code compliance - Control wiring connections must comply with the NEC and all other applicable codes.

WARNING

Verify that all incoming high-voltage (power) and low-voltage (control) circuits are de-energized and locked out before installing cables or making connections, whether in the junction box or in the unit.

Figure 9 Simplified shutdown circuit

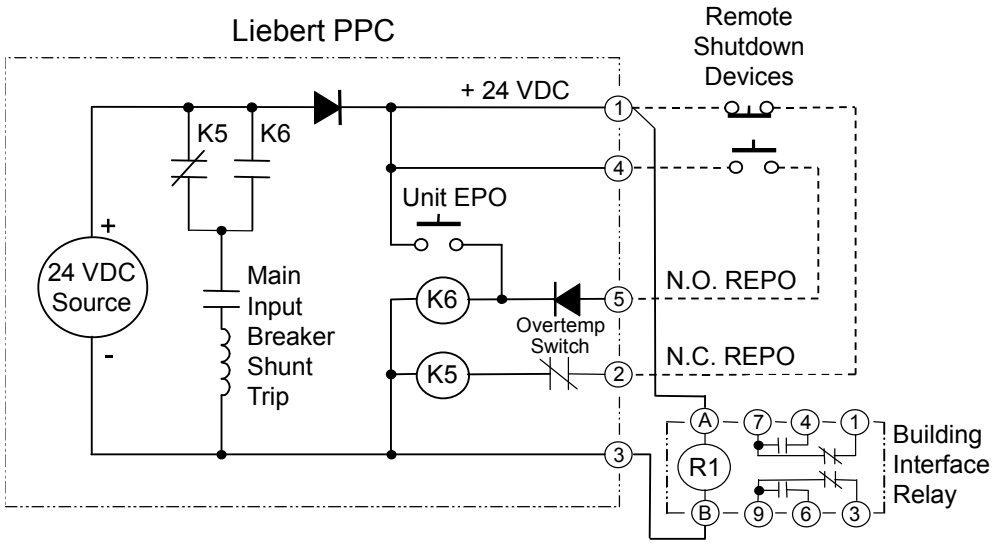
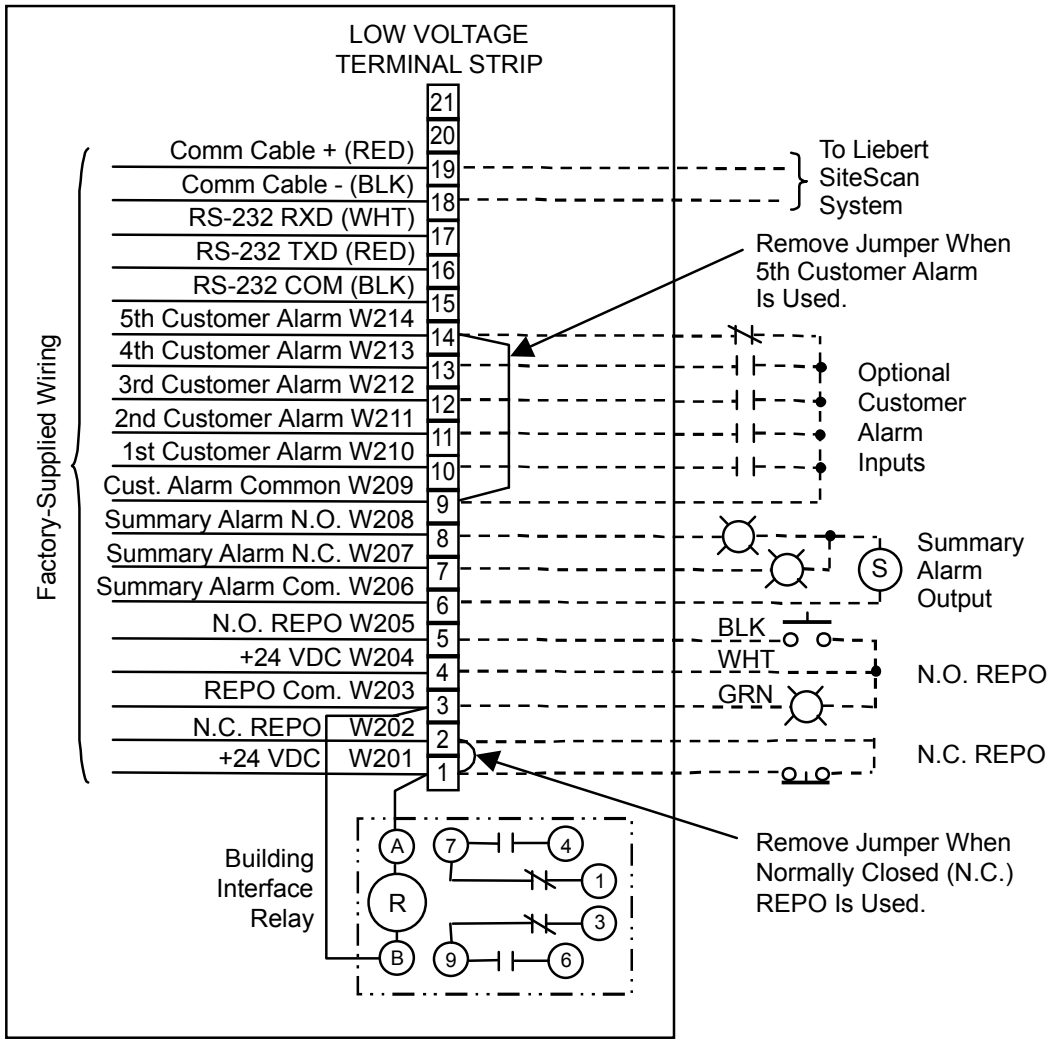


Figure 10 Typical control wiring for power monitoring



NOTES

1. Building interface relay can be used for remote shutdown or alarm. Relay is energized during normal operation. DPDT contacts rated 1/4 hp at 120VAC, 10A at 28VDC or 240VAC.
2. Other N.O. REPO devices may be wired in parallel to the N.O. REPO contacts. Other N.C. REPO devices may be wired in series to the N.C. REPO contacts. Multiple REPO lamps and other 24VDC loads may be wired in parallel to the REPO lamps. Maximum 24VDC supply available is 1A total. Both N.O. and N.C. REPO switches are powered from the same supply.
3. All auxiliary control devices and cabling to be field-supplied except as noted.
4. Overtemperature alarm contacts change state when unit overtemperature is sensed.
5. RS-232 port must be connected to low voltage terminal strip inside unit. Connect using suitable 300V communication cable.

2.0 INSPECTION AND STARTUP CHECKLIST

Unit Serial Number: _____

Unit Model Number: _____

Date: _____

2.1 Internal Inspection Overview

A detailed internal inspection should be performed after the unit is in place and before it is energized, to ensure trouble-free startup. The same internal inspection should be carried out when performing preventive maintenance.

WARNING

Verify that all incoming power and control circuits are de-energized and locked out before performing the internal inspection.

- **Open the unit** - Remove the exterior panels to gain access to the internal components of the Liebert PPC.
- **Visually inspect** - Check to make sure wiring and components are not damaged.
- **Check power connections** - Check all power connections for tightness. Refer to **Table 4** for torque requirements of all electrical connections.
- **Perform formal detailed inspection** - Follow the procedures described in the next section, **2.2 - Internal Inspection Procedure** when performing detailed inspection.

2.2 Internal Inspection Procedure

WARNING

All equipment inspection procedures are to be performed with power to the unit turned off and locked out.

EXTERIOR INSPECTION

___ 1. Confirm that the exterior of the unit is undamaged.

___ 2. Confirm that service and ventilation clearances are adequate (see **Figures 1** and **2**).

INTERIOR INSPECTION

___ 3. Remove accessible exterior panels.

NOTE

When removing exterior panels, ***disconnect panel ground wires by separating the easy-disconnect terminals located on the frame****. When replacing exterior panels, reconnect all panel ground wires.*

___ 4. Inspect all wire and conductor insulation for damage.

___ 5. Check all transformer terminal connections for tightness. Retorque if necessary.

___ 6. Check all breaker connections for tightness. Retorque if necessary.

___ 7. Check all terminal block connections for tightness. Retorque if necessary.

___ 8. Check transformer mounting bolts for tightness. Retorque if necessary.

___ 9. Remove any foreign objects from the components and the interior area of the unit. **Make sure air passages on transformers are clear and free of debris.**

___ 10. Check that the intake and exhaust air screens are clean and free of obstructions.

___ 11. Replace side panels, leaving access to circuit breakers for the following startup procedure.

NOTE

When replacing the side panels, be sure to reconnect the panel ground wires.

2.3 Startup and Monitoring System Check Overview

Checklists - Follow the detailed step-by-step instructions in the following two sections when installing and starting up the Liebert PPC:

- **2.4 - Startup Procedure**
- **2.5 - Monitoring System Check**

Initial system startup - A qualified electrician should be employed to perform the equipment inspection and startup. Liebert system startup may be arranged by contacting your local Emerson sales representative or Emerson Network Power Liebert Services at 1-800-543-2378.

Warranty - A copy of the checklist furnished with the unit must be completed, signed, dated and returned to Emerson Network Power (see **Section 2.6**). Warranty coverage of the equipment is not effective unless the checklist is received by the factory.

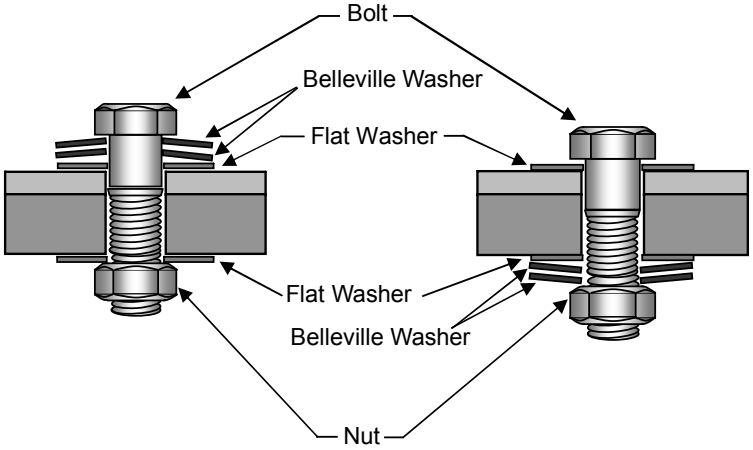
WARNING

Equipment inspection and startup should be performed only by trained personnel. Hazardous voltages are present during startup procedures. Electrical safety precautions must be followed throughout inspection and startup.

Table 4 Torque specifications (unless otherwise labeled)

Nut and Bolt Combinations				
Bolt Shaft Size	Electrical Connections With 1 Belleville Washer		Electrical Connections With 2 Belleville Washers	
	lb-in	N-m	lb-in	N-m
1/4" M6	40	4.52	80	9.04
5/16" M8	80	9.04	160	18.08
3/8" M10	120	13.56	240	27.12
1/2" M12	480	54.23	-	-

Figure 11 Acceptable hardware configurations for torque specifications (Table 4)



2.4 Startup Procedure

WARNING

Startup procedures should be performed only by qualified personnel. Hazardous voltages are present in the equipment throughout the majority of the startup procedure. Use proper safety equipment. Proceed with caution.

___ 1. Make certain that all circuit breakers are in the Off position and that power to the unit is locked out.

___ 2. Verify proper input power connections to unit, including equipment grounding conductor and local grounding electrode conductor.

___ 3. Turn On the building input power to the unit.

___ 4. Check the phase rotation at the main input breaker. Phase rotation should be A, B, C, left-to-right.

___ 5. Check and record the input voltage at the main input breaker. Measured voltages should correspond to the unit's nameplate input voltage.

Volts, phase A to phase B =_____
Volts, phase B to phase C =_____
Volts, phase C to phase A =_____

___ 6. Turn On the main input breaker; wait one minute. (If breaker trips Off, check for wiring errors including control connections. Contact Liebert Services or the location factory representative for assistance.)

___ 7. Check the phase rotation at the line side terminals of the panelboard or panelboard main breaker(s). The rotation should be A, B, C, left-to-right.

___ 8. Check and record the voltages at the line-side terminals of the output circuit breaker. Measured voltages should correspond to the unit's nameplate output voltage (within +4%, 0%).

Volts, phase A to phase B =_____
Volts, phase B to phase C =_____
Volts, phase C to phase A =_____
Volts, phase A to neutral =_____
Volts, phase B to neutral =_____
Volts, phase C to neutral =_____

If output voltage is incorrect, check for wiring errors, incorrect input voltage, or improper transformer tap. Contact Liebert Services at 1-800-543-2378 or your local Emerson representative for assistance.

NOTE

The Liebert PPC transformer has input voltage taps for each input phase:

- *For 300kVA units, the taps are arranged in 2-1/2% increments. Taps include: two above nominal voltage (upper range limit of +5%) and four below nominal voltage (lower range limit of -10%).*
- *For 450kVA units, the taps are arranged in 3% increments. Taps include: two above nominal voltage (upper range limit of +6%) and three below nominal voltage (lower range limit of -9%).*
- *For 800kVA units, the taps are arranged in 4% increments. Taps include: two above nominal voltage (upper range limit of +8%) and two below nominal voltage (lower range limit of -8%).*

This permits the transformer to provide the proper output voltage for a range of input voltages. Should it be necessary, the tap arrangement may be changed to match the input voltage:

a. Open the main input circuit breaker.
b. Select tap arrangement to match input voltage. (Refer to transformer nameplate for tap information.)
c. Secure each line to its proper tap.
*d. Repeat **Steps 6** to **8**.*

___ 9. Depress the local Emergency Power Off (EPO) switch and verify system shutdown. Turn the unit back on.

___ 10. If the system is equipped with any Remote Emergency Power Off (REPO) switches, test each to ensure proper operation. Note that the REPO switch may shut down more equipment or systems than just the Liebert PPC.

2.5 Monitoring System Check

___ 1. **Basic Indicators**:
   a. Turn On the building power to the unit, then turn the main input breaker On.
   b. Check that the local **Emergency Power Off** button is illuminated and the **Alarm Present** button is off (not illuminated).

___ 2. **Manual Restart Check** - if the unit is equipped with manual restart:
   a. Turn on building power to the unit. Turn the main input breaker On.
   b. Turn off all building power to the unit.
   c. Observe that the main input breaker automatically trips open upon power loss.
   d. Restore building power to the unit and return the main input breaker to On.

___ 3. **Power Monitor Panel**:
   a. Turn the unit On.
   b. Ensure that the voltage values indicated by the Monitor Panel correspond to the voltage values measured at the main input circuit breaker (**Step 5** in **2.4 - Startup Procedure**) and output circuit breaker (**Step 8** in **2.4 - Startup Procedure**).

___ 4. **Centralized Monitoring System** - if the unit is connected to a centralized monitoring system:
   a. Turn the unit and centralized monitoring system On.
   b. Verify proper communication to the monitor system operation.

___ 5. **Control Voltage**:
   a. Obtain access to the low voltage terminals in the low voltage control section inside the unit.
   b. With the unit On, measure and record the DC control voltage on terminals 1 (+) and 3 (com).
   c. Control voltage = _____ (Voltage should be between 20 and 28VDC).

___ 6. **Customer Alarms**:
   a. With the unit On, simulate alarm operation by jumpering the appropriate low voltage control terminals. (Refer to the control wiring installation drawing furnished with the unit.)
   b. Verify correct alarm operation by the Power Monitor Panel and/or by the centralized monitoring system.

2.6 Send Completed Checklist to Emerson Network Power

After performing all procedures described in this section, **2.0 - Inspection and Startup Checklist**, sign, date and return the completed Inspection and Startup Checklist form furnished with the unit to:

Emerson Network Power
1050 Dearborn Drive
P.O. Box 29186
Columbus, Ohio 43229 USA

NOTE
Warranty is not in effect unless the Inspection and Startup Checklist form is received by the factory.

3.0 OPERATING INSTRUCTIONS

3.1 Startup Procedures

Before the unit is placed into service after initial installation, after equipment relocation or after equipment has been de-energized for an extended period of time, perform equipment inspection and startup procedures as detailed in **2.0 - Inspection and Startup Checklist**.

After initial system startup, use the following guidelines for standard equipment operation. These guidelines should be reviewed for any special equipment modifications, special site considerations or company policies that may require changes to the standard equipment operation.

3.1.1 Emergency Shutdown

To perform an immediate system shutdown during emergency conditions, lift the protective clear cover and push the EPO switch on the front door of the unit.

NOTE
Depending on the control circuit wiring, operation of the unit EPO switch may cause other equipment to shut down.

If the site is equipped with a REPO switch—for example, as required by NEC Article 645 at the principal exit doors—activate one of the REPO switches to perform an immediate room shutdown.

3.1.2 Normal System Shutdown

To perform a normal system shutdown

- Shut down the load equipment—for example, a computer system—according to the manufacturer's recommendations. The load equipment can be turned Off at each piece of load equipment or at the Liebert PPC's output distribution (circuit breaker) panels located behind the unit's front door.
- Turn Off all unit output breakers, then turn Off the unit's main input circuit breaker.
- To remove all power from the unit, turn Off the building power to the unit's input breaker or junction box.

3.1.3 Normal System Startup

Make certain all unit circuit breakers are in the Off position. All unit circuit breakers are located behind the front doors, as shown in **Figure 12**.

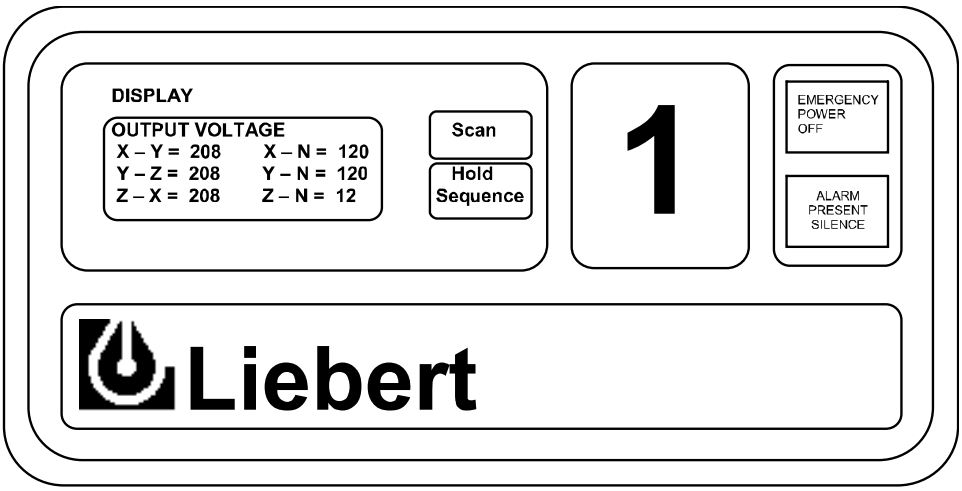
- Turn On building power to the unit.
- Turn On the unit's main input circuit breaker.
  - If the circuit breaker has been tripped Off (instead of being turned Off), the circuit breaker handle must be moved to the Off position before being turned On.
  - If the unit has a voltage monitoring panel, verify proper output voltages before turning On output circuit breakers.
- Turn On the panelboard main breakers, if supplied.
- Individually turn On each output circuit breaker following the load equipment manufacturer's startup sequence.

Figure 12 300-450kVA unit with doors open

3.1.4 Manual Restart

If the unit's manual restart feature has been selected, the unit's main input circuit breaker will be tripped by a power outage, preventing repetitive application of unstable voltage and allowing for an orderly system restart. If the main input circuit breaker is tripped by a power outage, follow the instructions in **3.1.3 - Normal System Startup** after power is restored.

3.2 Power Monitor Panel



Monitored Parameters - A 4-20 character LCD display is provided to indicate the input voltages (line-to-line), output voltages (line-to-line and line-to-neutral), output currents (each phase, neutral and ground), output voltage THD, output current THD, crest factor, K-factor, output kVA, kW, kW-Hours, power factor, percent load and output frequency. Press the **Scan** button to activate the Autoscan mode where all monitored parameters are sequentially displayed automatically. Momentarily press the **Hold/Sequence** button to interrupt the Autoscan mode. Press the **Hold/Sequence** button to allow manual selection of the sequentially displayed stage of overtemperature sensing. After correction of the alarm condition, the alarm will automatically reset.

Alarms - When any of the following alarms occurs, an alarm message appears on the LCD, the audible alarm is activated and the **Alarm Present/Silence** button is illuminated. Press the **Alarm Present/Silence** button to silence the audible alarm. After the alarm condition is corrected, press the **Alarm Present/Silence** button to reset the alarm when prompted by a message on the LCD or by any central monitoring system.

- **Output Overvoltage** - Indicates one or more of the output phase voltages has exceeded the preset limit (normally +6% of nominal). The high output voltage should be verified and corrective action taken. In the absence of other procedures, a normal (orderly) system shutdown should be performed to prevent load equipment damage.
- **Output Undervoltage** - Indicates one or more of the output phase voltages has exceeded the preset limit (normally 13% of nominal). The low output voltage should be verified and corrective action taken. In the absence of other procedures, a normal (orderly) system shutdown should be performed to prevent load equipment damage.
- **Output Voltage THD** - Indicates that the voltage distortion on one or more of the output phases has exceeded the preset limit (normally 10% THD). The cause of the high output voltage distortion should be investigated and corrective action (if any) taken.
- **Transformer Overtemp** - Indicates a unit transformer overtemperature condition. The cause of the overtemperature condition should be investigated and corrected. Possible causes are unit overload, excessive non-linear loading, inadequate ventilation, high or low input voltage and a monitoring malfunction. Failure to correct the overtemperature condition may result in an automatic system shutdown due to the second stage of overtemperature sensing.
- **Output Overcurrent** - Indicates one or more of the output phase currents has exceeded the preset limit (normally 95% of the unit's full load amp rating). The overcurrent condition should be verified and corrective action taken. In the absence of other procedures, some of the output loads should be turned off to reduce unit loading. If unbalanced phase currents exist, some of the loads should be shifted from higher loaded phases to lower loaded phases.
- **Neutral Overcurrent** - Indicates that the neutral current has exceeded the preset limit (normally 95% of the unit's full load amp rating). The overcurrent condition should be verified and investigated to see if corrective action is required. In some cases, high neutral current indicates phase current unbalance which should be corrected. Where high neutral currents are the result of harmonic load currents, all affected components (including output wiring) should be verified to be suitable for the current.

- **Frequency Deviation** - Indicates that the output frequency has exceeded preset limits (normally 0.5Hz). The frequency deviation should be verified and the cause investigated and corrected.
- **Phase Sequence Error** - Indicates that the output phase sequence is not A, B, C. The phase sequence should be verified and corrective action taken. Three-phase loads sensitive to phase sequence should not be operated without proper phase sequence.
- **Phase Loss** - Indicates that one or more of the phase voltages is low or missing. The low voltage condition should be verified and corrective action taken. In the absence of other procedures, a normal (orderly) shutdown should be performed to prevent equipment damage.
- **Ground Overcurrent** - Indicates the system ground current has exceeded the preset limit (normally 5A). The overcurrent condition should be verified and corrective action taken. Possible causes are wiring errors, ground faults and excessive leakage current.
- **Customer Alarms (5)** - Indicates customer-designated alarms. The cause and corrective action depend on the nature of the alarm. See **1.2.7 - Control Wiring Connections** for contact closure connection information.

To Set Clock/Language Selection - To set the clock or change the language selection from the unit front panel, simultaneously press the **Scan** and **Hold** membrane buttons while the time and date screen is displayed on the LCD. A cursor appears on the selected time and date field. Use the **Scan** button to increment the highlighted field and the **Hold** button to decrement the highlighted field. Use the **Silence** push button to select the next time and date field. The time can be displayed in AM/PM or 24-hour format. Simultaneously press the **Scan** and **Hold** buttons to exit the clock/language set screens.

RS-232 ASCII Communications Port - Units with power monitoring are equipped with an isolated RS-232 ASCII communications port, which allows access to unit-monitored parameters and alarm information. The RS-232 port connections are located on the low voltage control terminal strip inside the unit. See typical control wiring in **Figure 10**.

The ASCII interface default parameters are as follows:

Interface	RS-232 Using EIA Voltage Levels
Baud Rate	9600
Parity	None
Data Bits	8
Stop Bits	1
Terminator	<CR>
Hand Shaking	Not Supported
Structure	Half-Duplex
Echo	Off
Change to Receive After Transmit	1.28 msec
Minimum Delay to Transmit After Receive	120 sec
Maximum Response Time Turnaround	300 msec
Maximum Response Completion Time	500 msec
Minimum Delay Between Commands	500 msec
Maximum Intercharacter Delay	12.5 msec

The ASCII port uses a Query-Response Format.

The list of available customer commands is shown in **Table 5**.

Only one command is serviced at a time. Valid commands are terminated with a carriage return [0Dh]. Commands are accepted in upper- or lowercase. Responses are in uppercase, terminated with a line feed [0Ah] and carriage return [0Dh].

Table 5 RS-232 ASCII port customer commands

Command	Description	Typical Response
Time?<CR> Date?<CR>	Unit time Unit date	03:40:37A <LF><CR> 05-15-97 <LF><CR>
UID?<CR> KVA?<CR> V?<CR>	Unit ID Nominal kVA Nominal L-L voltage	Unit_No._PDU_21B_ _ _ _<LF><CR> 0150<LF><CR> 0208<LF><CR>
SS1?<CR>	System information (20-character fields with comma separators)	UNIT_MODEL_NUMBER_ _ _,SERIAL_NUMBER_ _ _ _ _ _ _, SITE_ID_NUMBER_ _ _ _ _ _,TAG_NUMBER_ _ _ _ _ _ _ _ _ _ <LF><CR>
SA?<CR>	Number of current alarms, 20-character alarms with time stamp	02,OUTPUT_OVERVOLTAGE_ _,05-15-97,01:25:30A, OUTPUT_OVERCURRENT_ _,05-15-97,01:27:46A<LF><CR>
UPMD?<CR>	Monitored parameters, 32 comma-separated data fields (see **Table 6** for descriptions of field positions)	0484,0485,0483,0210,0212,0211,0121,0122,0121,0068, 0085,0120,0131,0018,0030,0092,0033,0600,0038,0041, 0043,0549,0632,0599,00001528,0018,0019,0020,0045, 0047,0049,0044<LF><CR>

Table 6 Monitored parameters data definitions

Field Number	Data Item	Units	Field Number	Data Item	Units
1	Input Voltage A-B	Volts	17	Output Power	kVA
2	Input Voltage B-C	Volts	18	Output Frequency	0.1 Hz
3	Input Voltage C-A	Volts	19	Output Vx THD	0.1%
4	Output Voltage X-Y	Volts	20	Output Vy THD	0.1%
5	Output Voltage Y-Z	Volts	21	Output Vz THD	0.1%
6	Output Voltage Z-A	Volts	22	Output Ix THD	0.1%
7	Output Voltage X-N	Volts	23	Output Iy THD	0.1%
8	Output Voltage Y-N	Volts	24	Output Iz THD	0.1%
9	Output Voltage Z-N	Volts	25	Output kW-Hrs	kW-Hrs
10	Output Current X	Amps	26	Output Ix Crest Factor	0.1
11	Output Current Y	Amps	27	Output Iy Crest Factor	0.1
12	Output Current Z	Amps	28	Output Iz Crest Factor	0.1
13	Neutral Current	Amps	29	Output Ix K-Factor	0.1
14	Ground Current	0.1 Amps	30	Output Iy K-Factor	0.1
15	Output Power	kW	31	Output Iz K-Factor	0.1
16	Power Factor	0.01 Power Factor	32	Output Loading	% of Full Load

4.0 MAINTENANCE

4.1 Corrective Maintenance (Repair)

Even the most reliable equipment may fail. Contact Liebert Services for fast repair of your unit and minimum downtime of your installation.

WARNING
Only qualified service personnel should perform maintenance on the Liebert PPC.

Standard electrical troubleshooting procedures should be used to isolate problems in the unit. If there are questions, contact Liebert Services.

Repair or replacement of standard items, such as circuit breakers, fuses, transformers, capacitors and indicator lights can be either handled by qualified electricians or referred to Liebert Services.

Repairs related to the monitoring system should be referred to Liebert Services.

To contact Liebert Services for information or repair service, call 1-800-543-2378.

4.2 Preventive Maintenance (Inspection & Cleaning)

Air circulation through the cabinet may cause dust to accumulate on internal components. Cleaning should be done as necessary during electrical inspections.

Annual general system inspections, cleaning and operation checks are recommended to ensure system performance and long service life.

WARNING

Only qualified service personnel should perform maintenance on the Liebert PPC. All voltage sources to the unit must be disconnected before inspecting or cleaning within the cabinet.

4.2.1 Inspection Schedule

- It is difficult to establish a schedule for periodic cleanings since conditions vary from site to site. Inspections after the first 24 hours, 30 days and 6 months of operation should help determine a pattern for the inspection schedule.
- Electrical connections and component mountings should be inspected after the first 24 hours, 30 days and 6 months of operation. Inspections should be conducted annually thereafter.
- Ventilation openings and grilles should be inspected and cleaned every six months to one year.
- A complete inspection and operational checkout should be performed annually. This is best done by performing the inspection and startup procedures outlined in **2.0 - Inspection and Startup Checklist**.
- Liebert Services offers a complete range of preventive maintenance services. These include thorough equipment performance checks and calibration of electronics. Contact Liebert Services at 1-800-543-2378 for details.

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SL-20048 _REV0_09-10

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